2.5 MHz Pbar Transfers in MI

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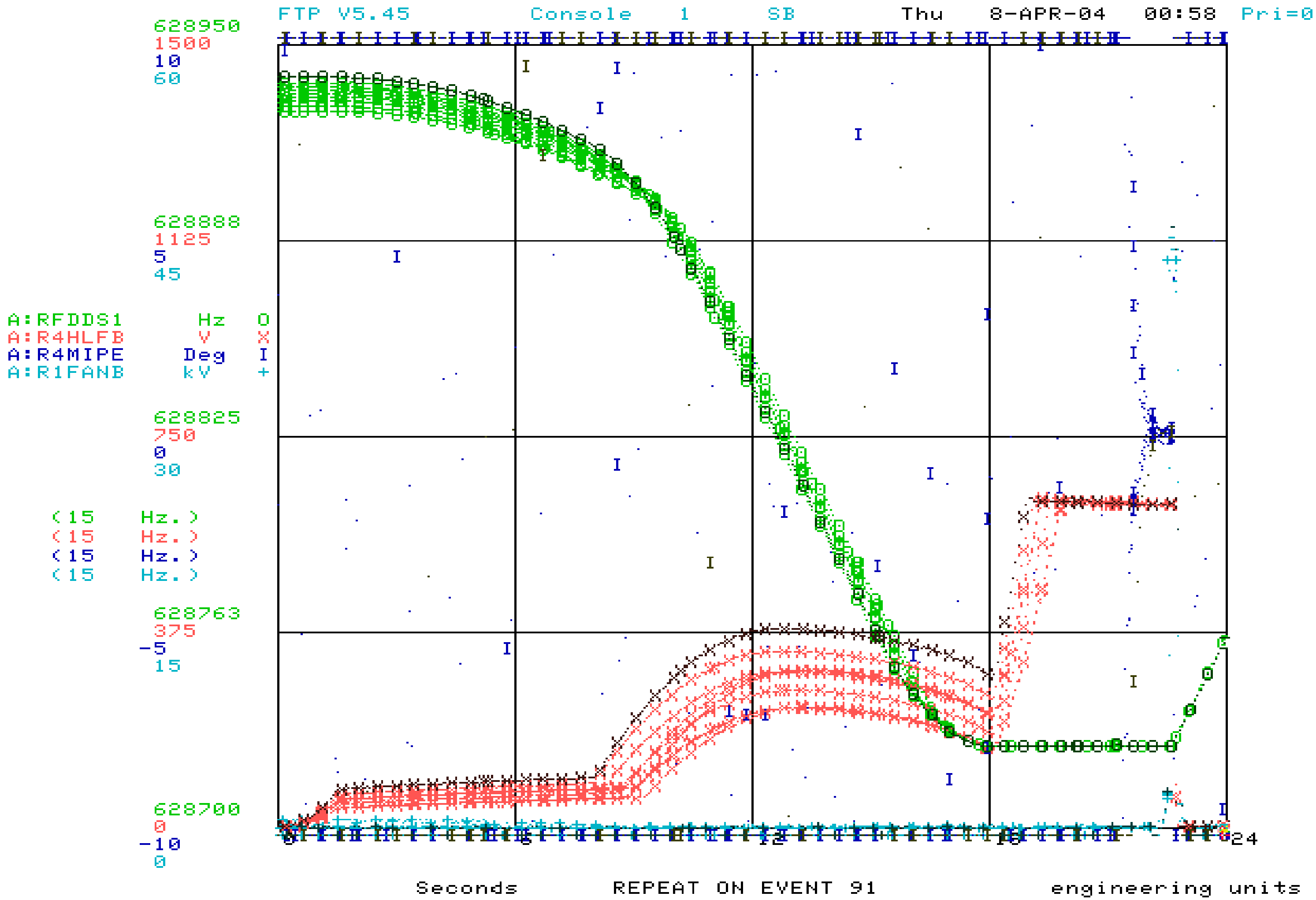
Accumulator to MI Pbar Transfers

- In the Accumulator a portion of the dense part of the stack is adiabatically captured with ARF-4 (2.5 MHz) rf voltage and accelerated to the extraction orbit. Then the ARF-4 voltage is turned up to narrow the h=4 2.5 MHz pbar bunches. Just before extraction the ARF-1 voltage is turned on to create between 7-11 53 MHz bunches.
- Pbars are transferred from Accumulator to MI in matching 53 MHz buckets, accelerated to 150 GeV and then coalesced.

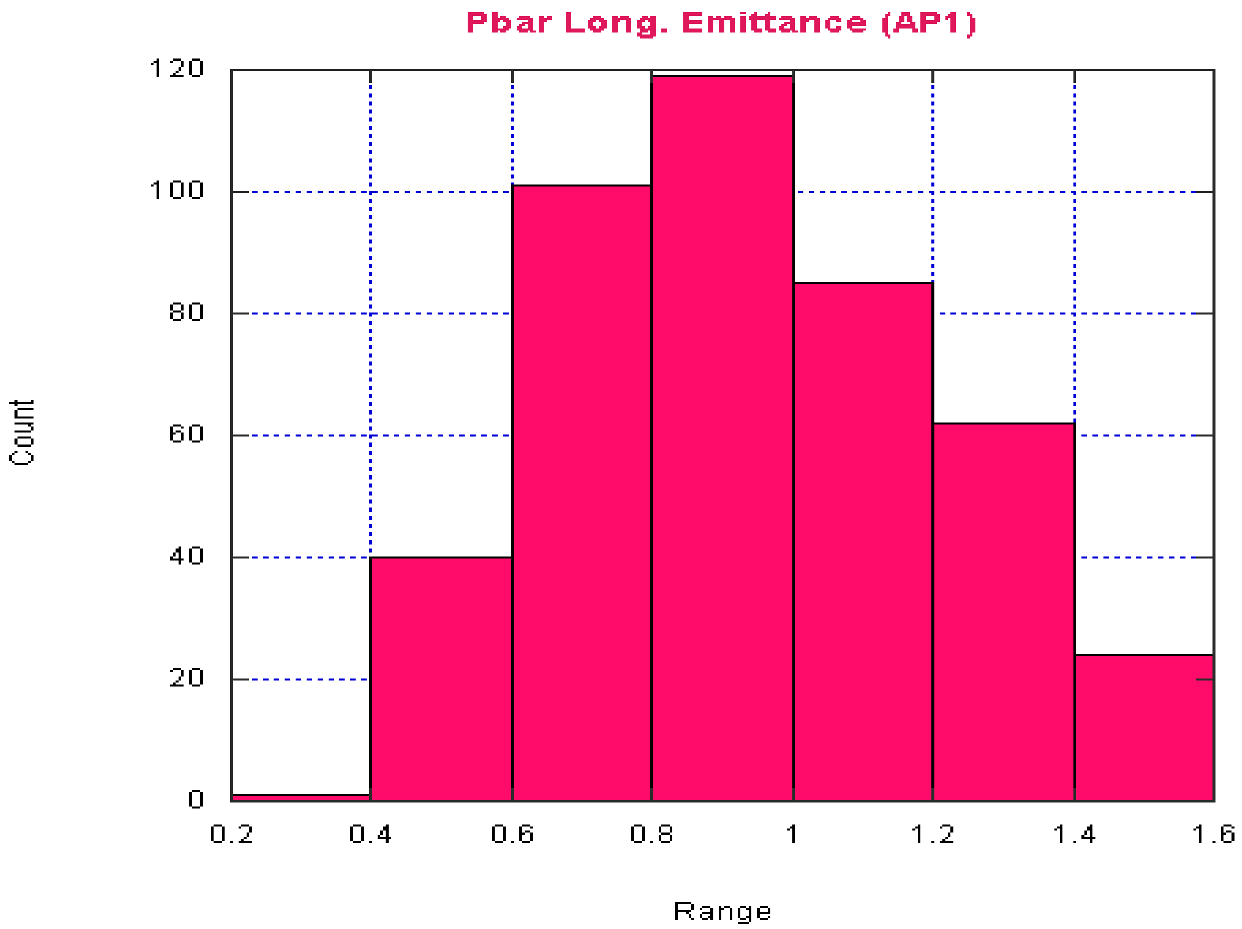
Accumulator 2.5 MHz (ARF4) and 53 MHz (ARF1) voltages during pbar Extraction



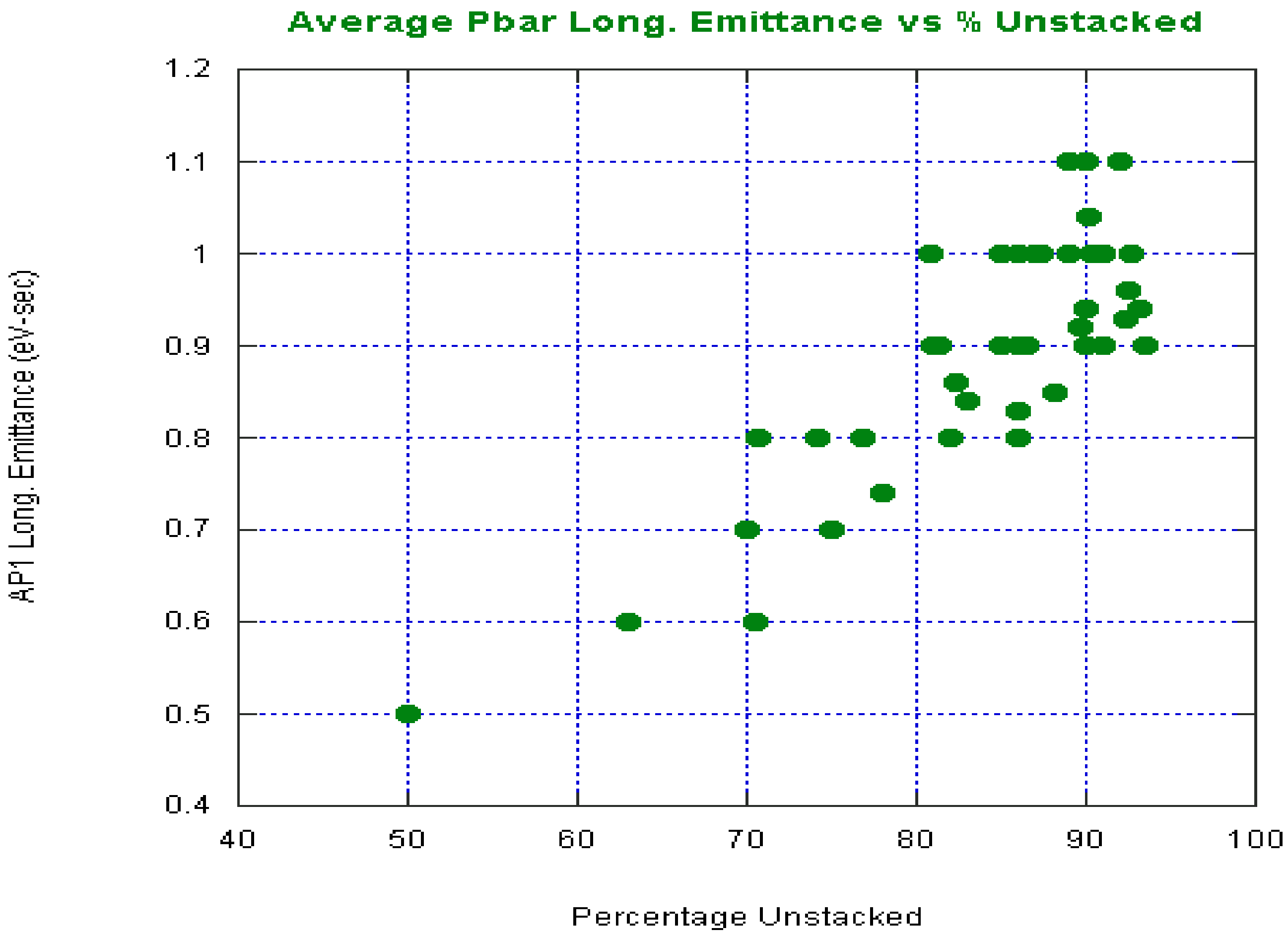
Some Facts

- The average 2.5 MHz longitudinal emittance of the extracted pbars is a function of the unstacked fraction of the stack.
- Since the maximum ARF-4 voltage is limited, the number of 53 Mhz bunches we end up in each pbar batch is a function of the 2.5 MHz bucket area extracted from the core.
- The pbar coalescing efficiency is a strong function of both the longitudinal emittance and the number of bunches we are trying to coalesce.
- If we limit the number of bunches that we are trying to coalesce to 7 or less the coalescing efficiency can be independent of the emittance (in the range of interest).

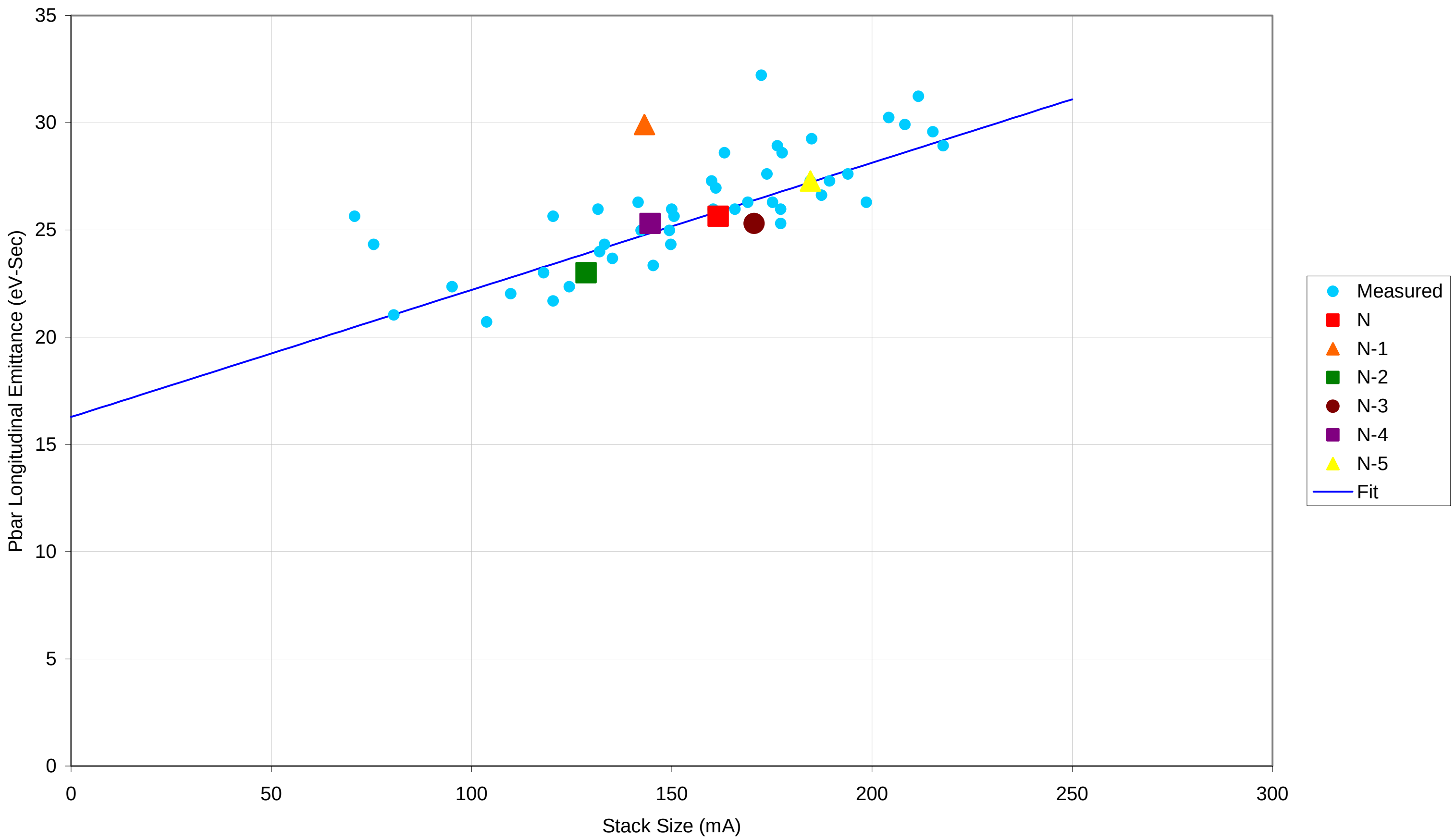
Range of pbar Longitudinal emittances (all transfers)



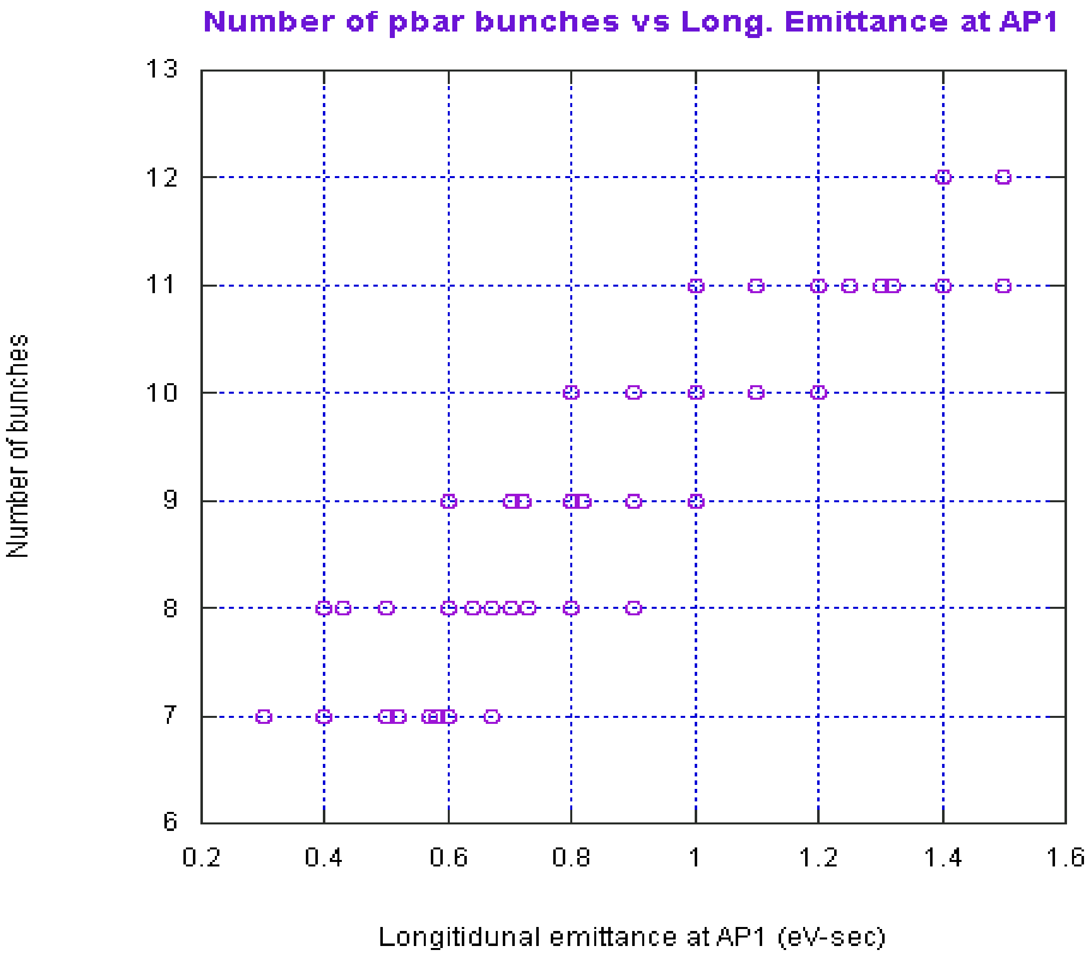
Average Pbar Longitudinal Emittance vs % Unstacked



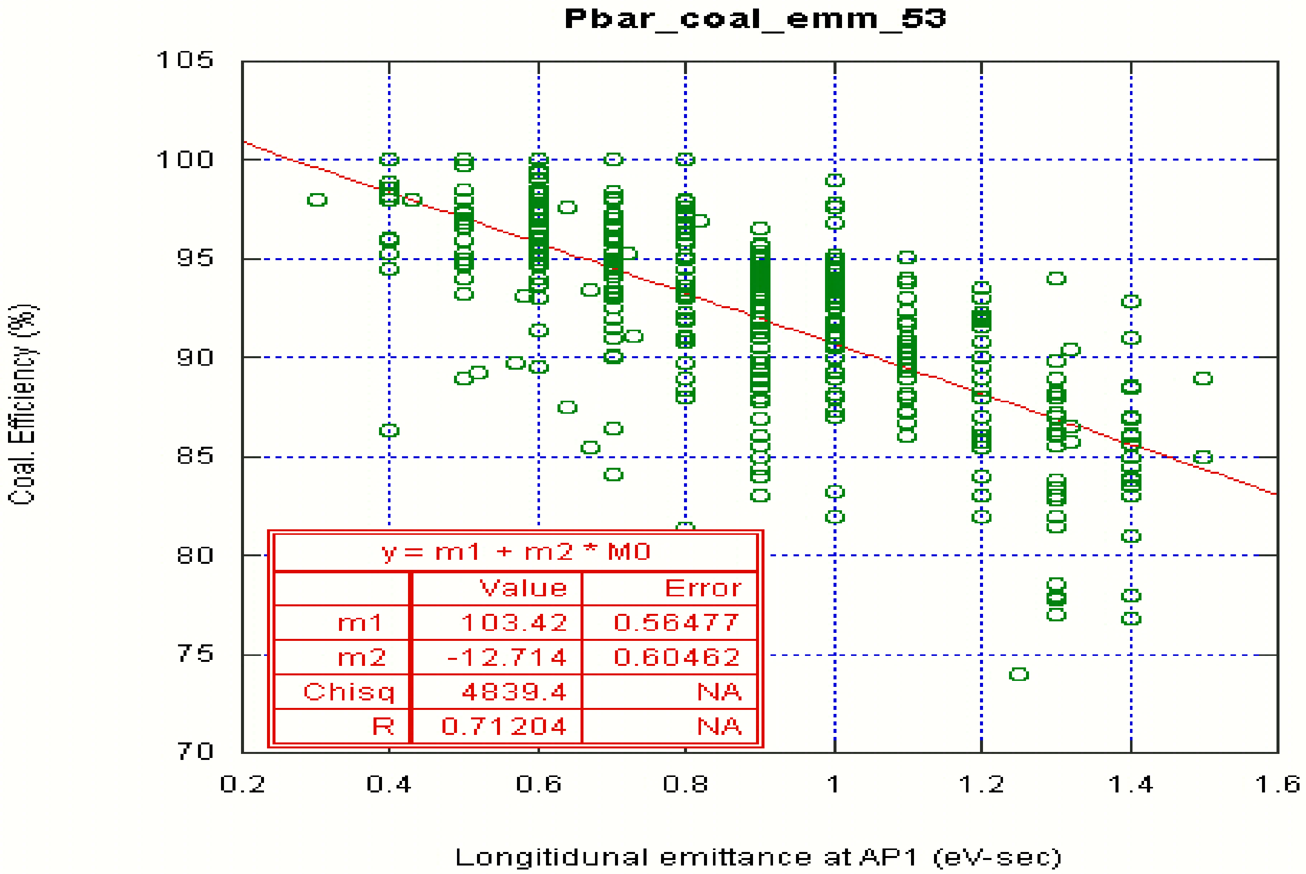
Total Pbar Longitudinal Emittance vs Stack Size



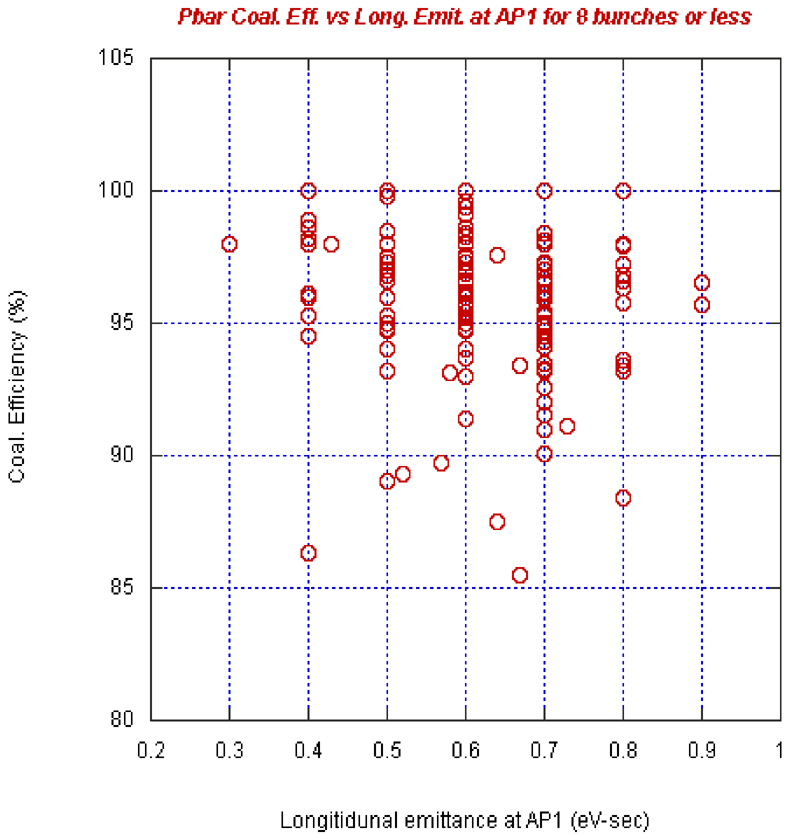
Number of 53 MHz pbar bunches vs 2.5 MHz Long. Emittance (all transfers)

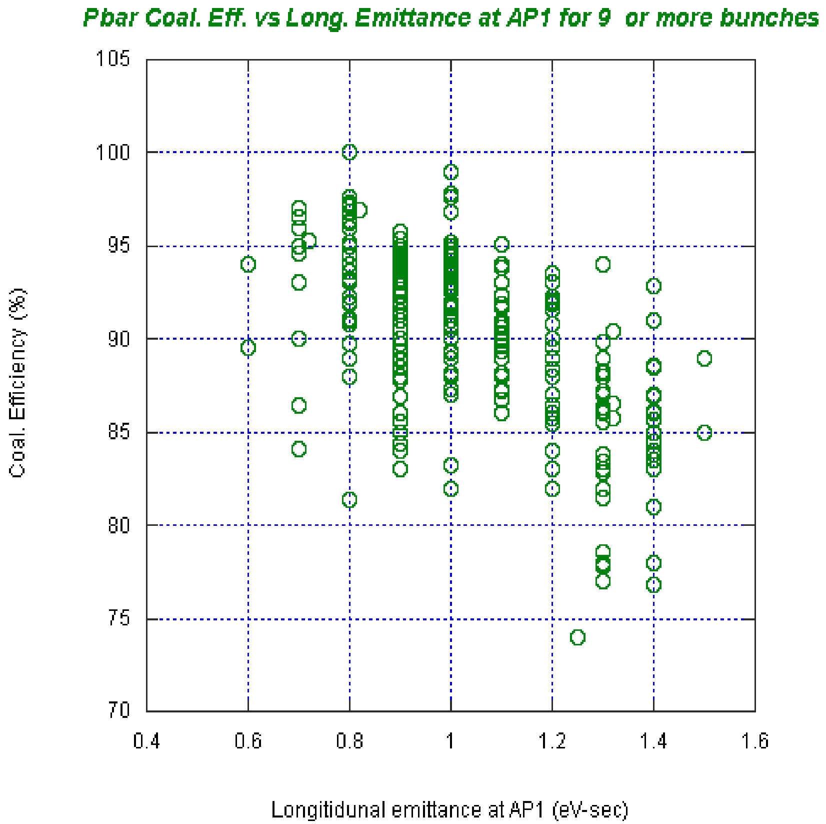


Pbar Coalescing Efficiency vs 2.5 MHz Pbar Longitudinal Emittance



Pbar Coalescing Efficiency vs pbar 2.5 MHz Longitudinal emittance (all transfers)

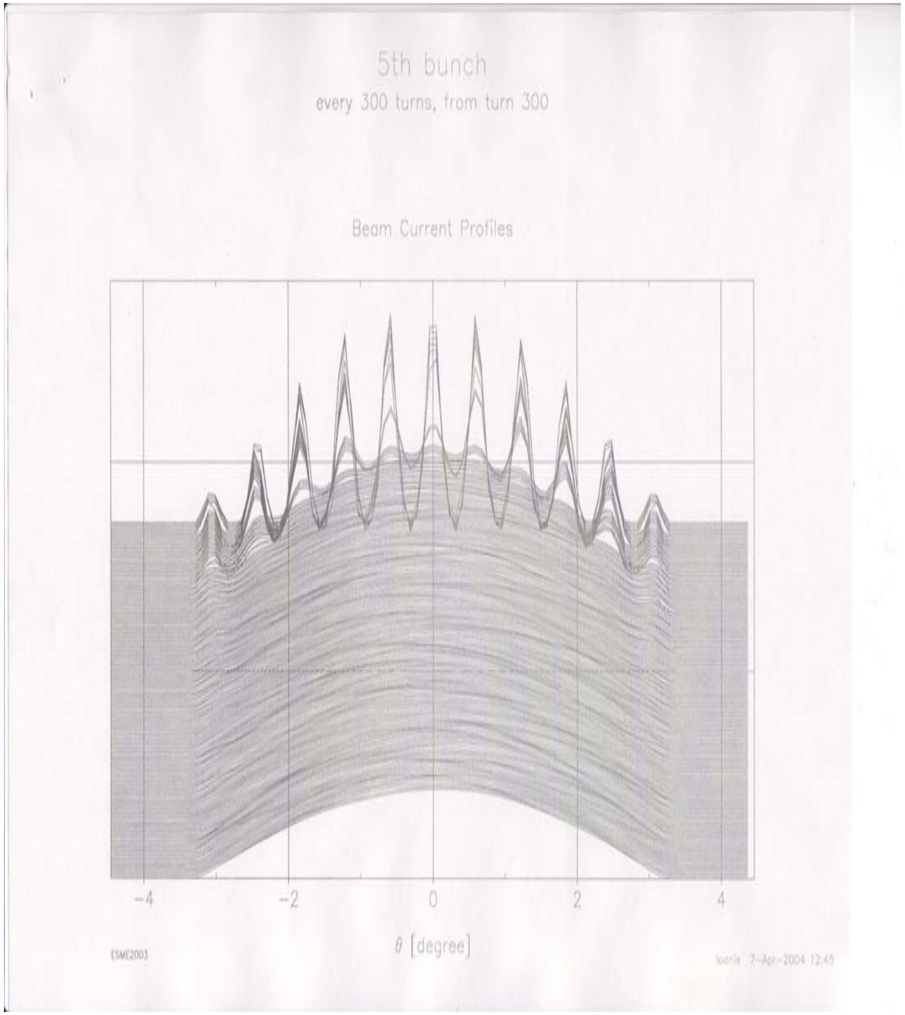




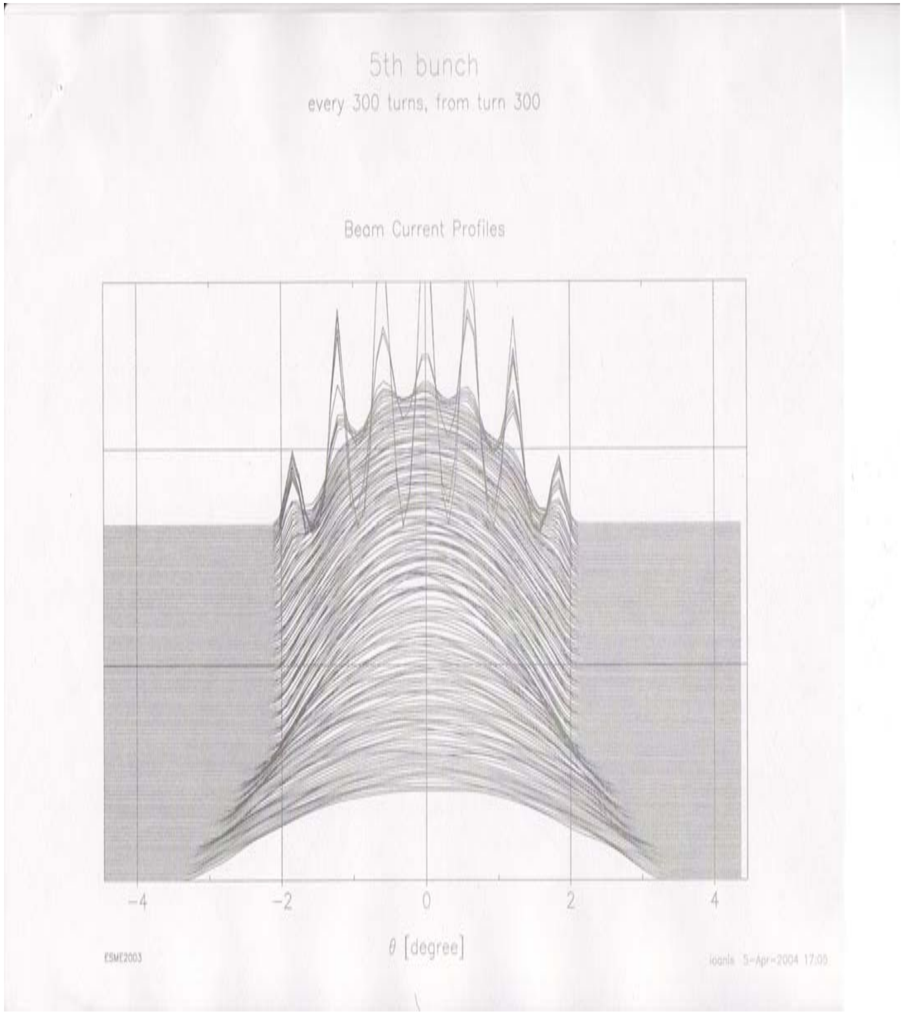
Why do 2.5 MHz Pbar Transfers

- Since Recycler has no 53 MHz rf, all pbar transfers to/from the RR have to happen in 2.5 MHz.
- The pbar transfers from Accumulator to RR go through MI.
- By doing the Accumulator to MI/RR transfers in 2.5 MHz we can avoid have to debunch and recapture the pbars in 2.5 MHz.
- In MI we have more than 60 KV of 2.5 MHz available which can be used to squeeze the 2.5 pbar bunches before recapturing in 53 MHz, limiting the number of 53 MHz bunches and greatly improving the pbar coalescing efficiency.

1.5 eV-sec 2.5 bunch captured with 2.0 KV of 2.5 MHz before raising the 53 MHz voltage in MI.

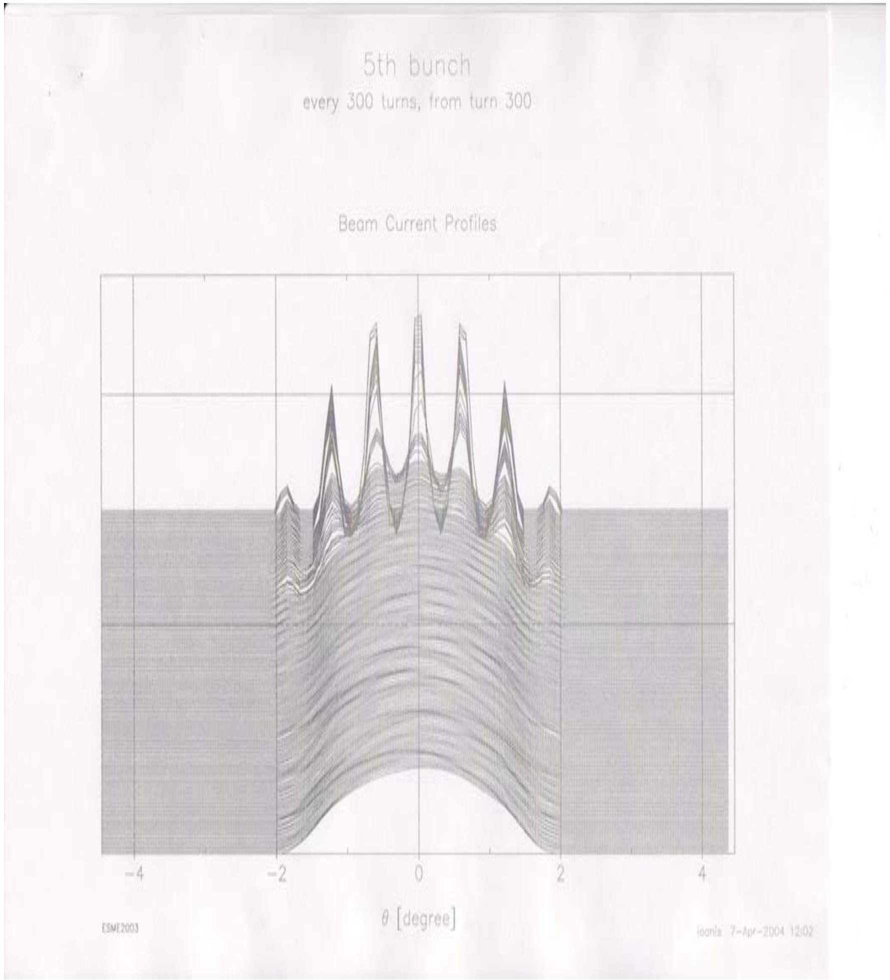


No squeezing (11 53 MHz bunches!)

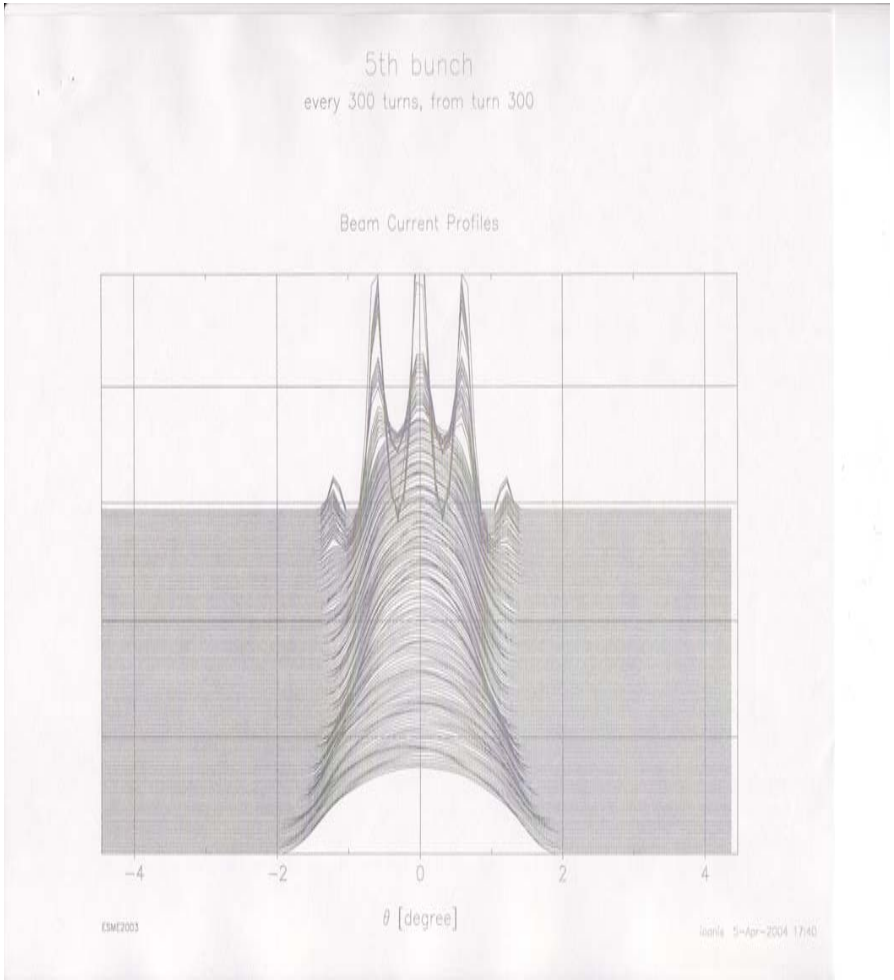


Squeezing with 12 KV of 2.5 MHz (7 53 MHz bunches!)

0.5 eV-sec 2.5 bunch captured with 2.0 KV of 2.5 MHz before raising the 53 MHz voltage in MI.

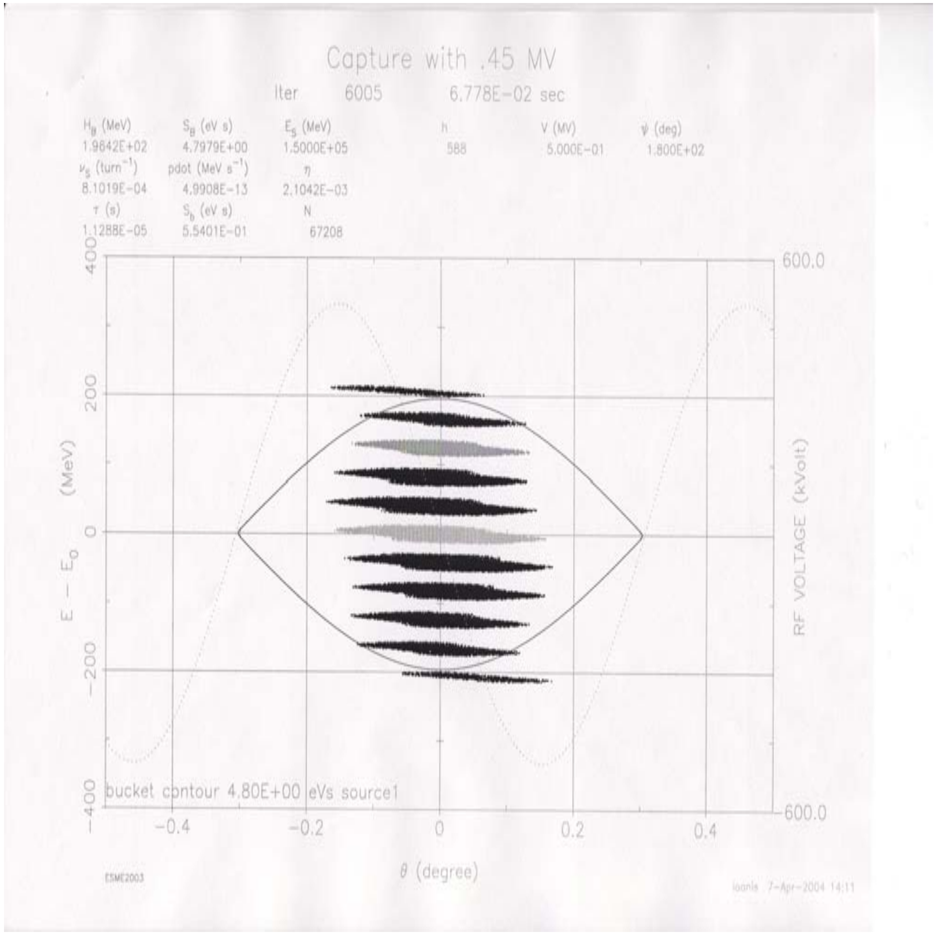


No squeezing (7 bunches)

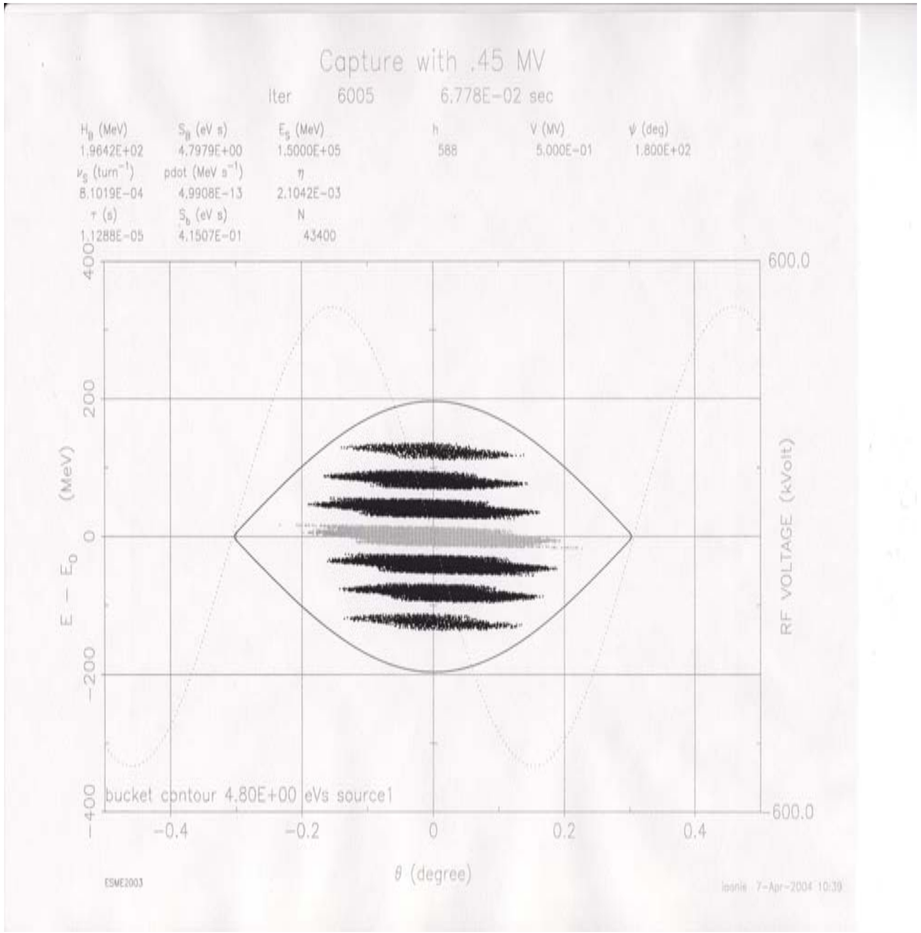


Squeezing with 12 KV of 2.5 MHz (5 bunches)

ESME Phase space plots of an 1.5 eV-sec pbar batch at recapture

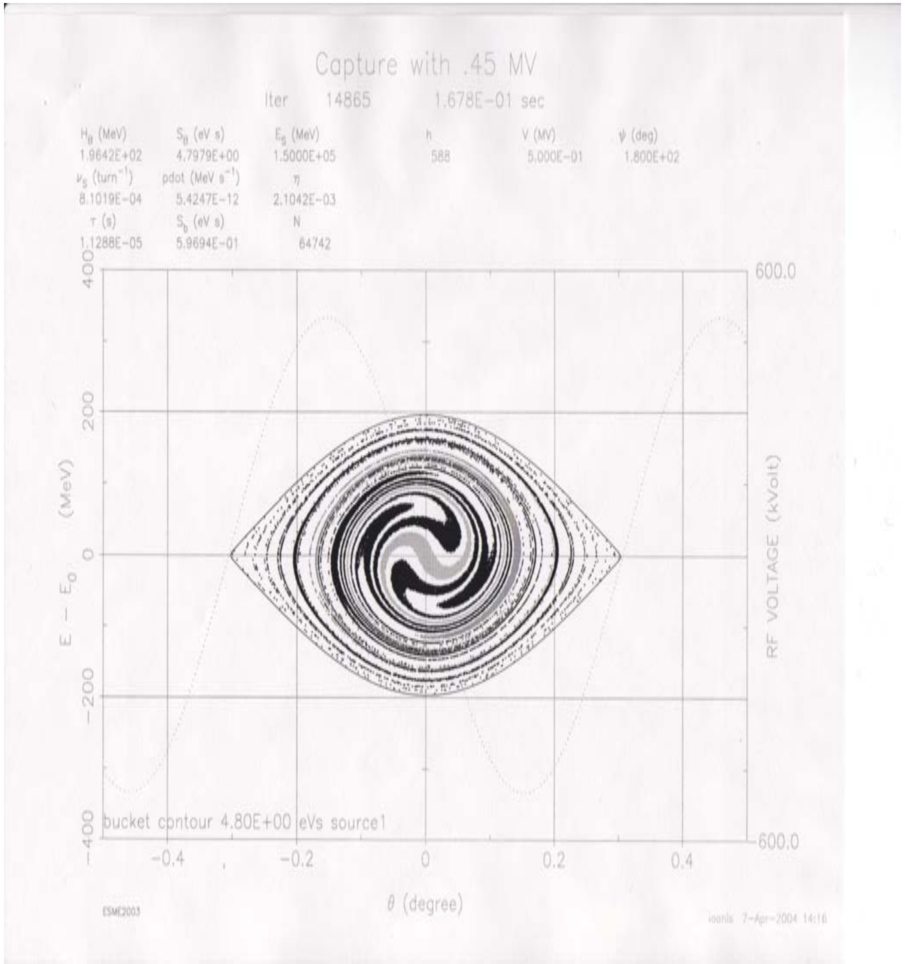


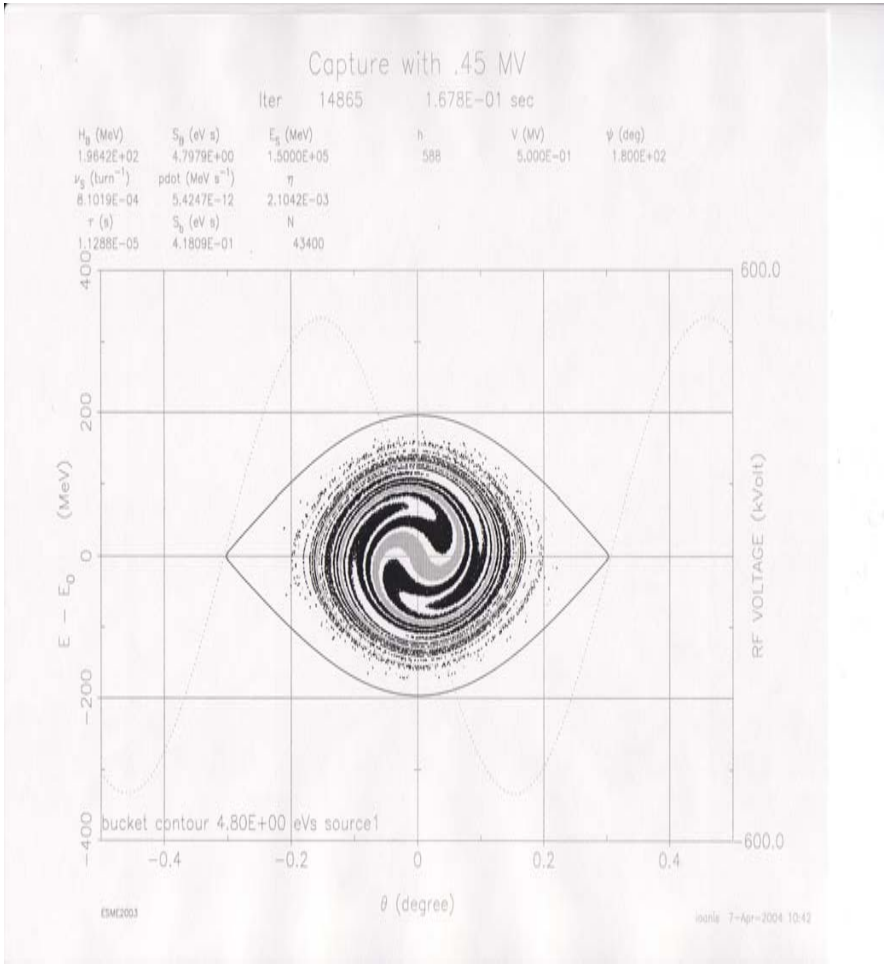
11 53 MHz Bunches



7 53 MHz Bunches

ESME Phase Space Plots of an 1.5 eV-sec pbar bunch





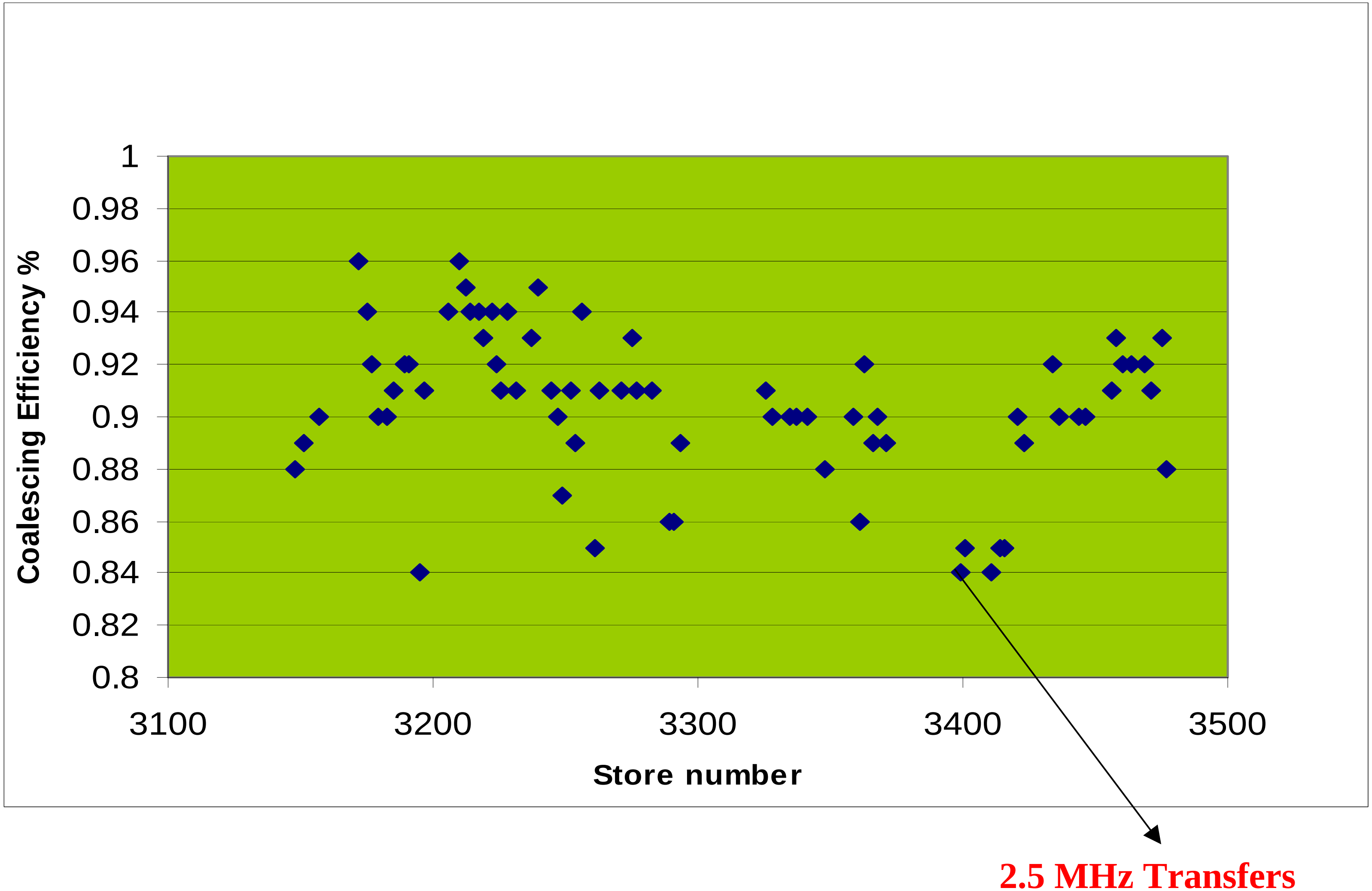
11 53 MHz Bunches (96% eff)

7 53 MHz Bunches (100% eff)

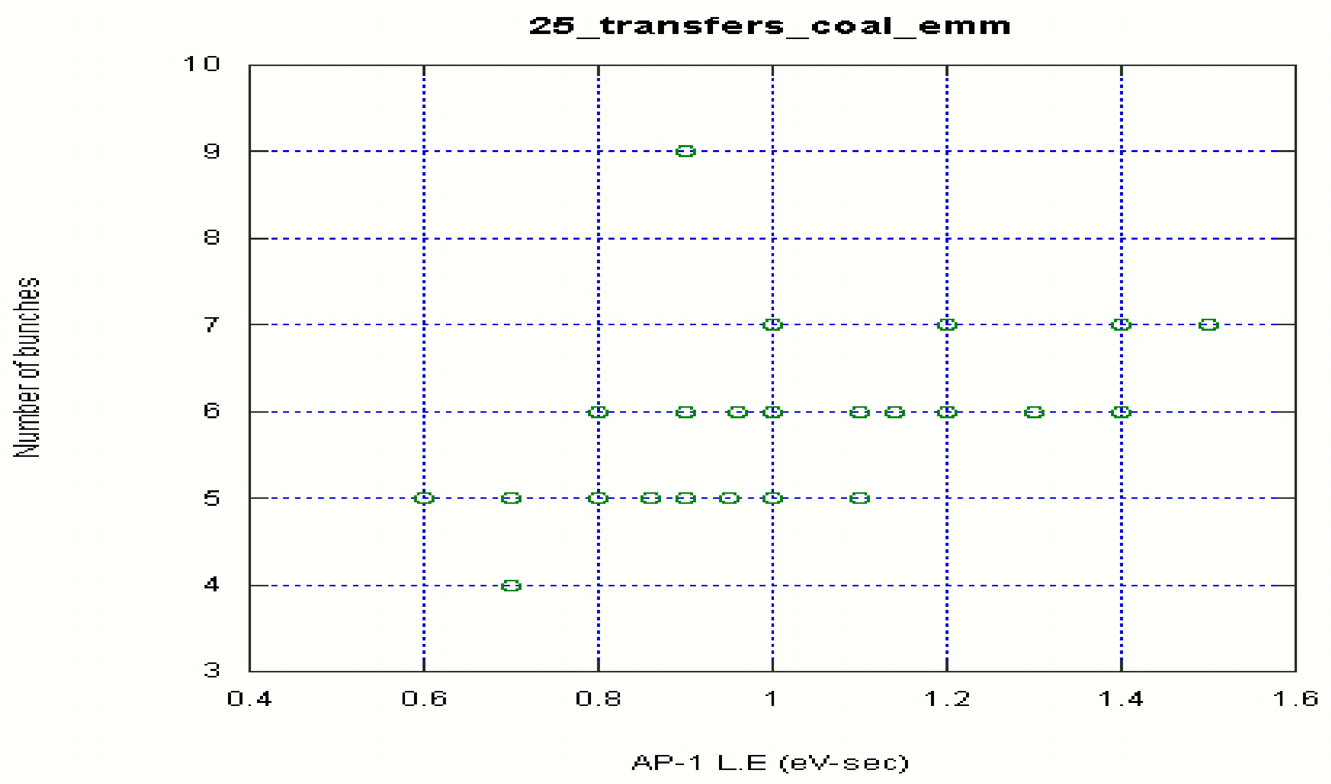
Current Status

- We have started the Accumulator to MI pbar transfers for stores on April 13.
- After some initial problems with 2.5 MHz phase jumping in MI we had pbar coalescing efficiencies in the low 90s.
- We are now getting 7 bunches or less for all longitudinal emittances from the pbar source.
- The current dependence of coalescing efficiency on longitudinal emittance is much weaker.
- With some more tuning we hope to achieve caoelscing efficiencies in the mid 90s.

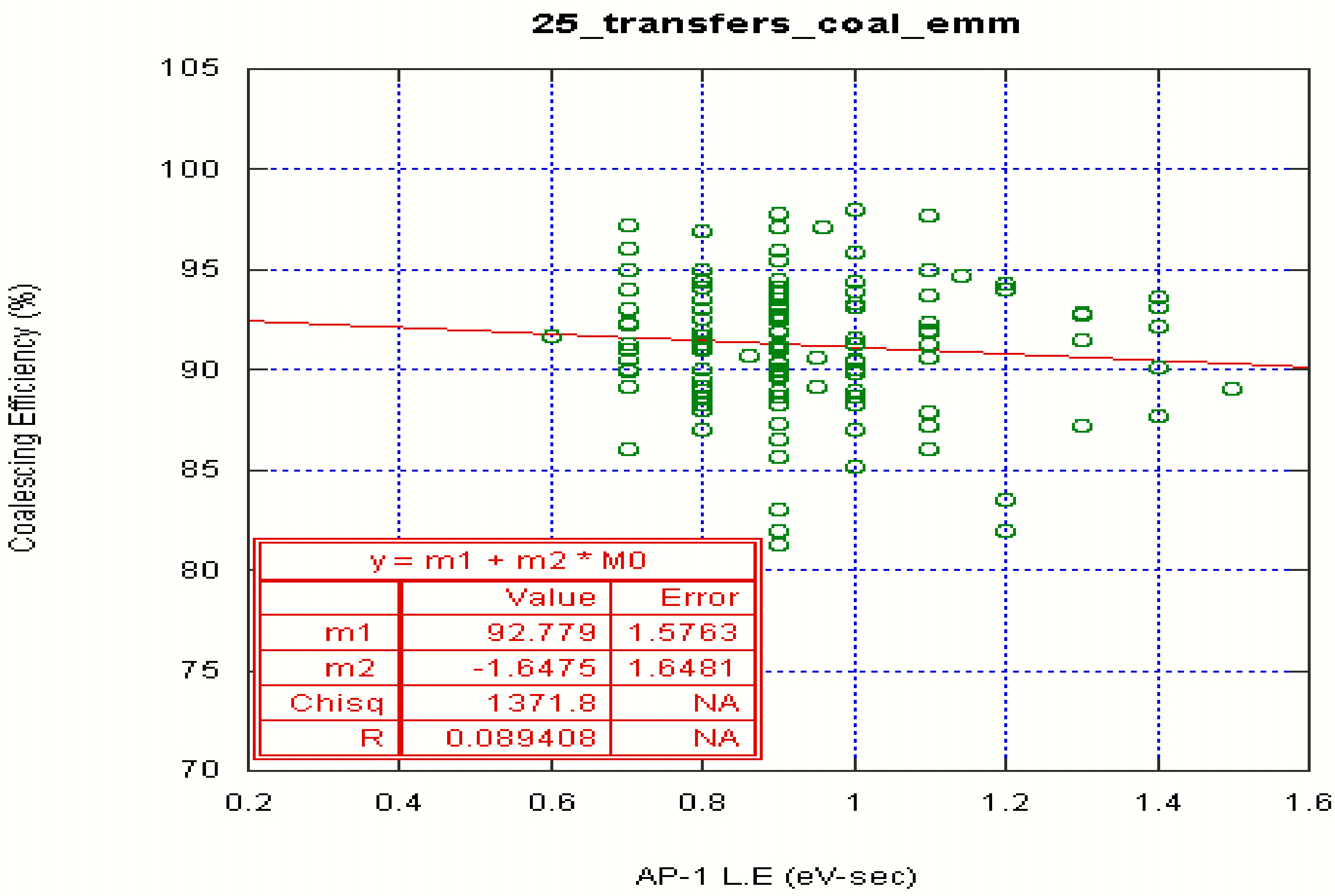
Pbar Coalescing Efficiency vs Store number since 01/01/04



Number of 53 MHz bunches vs 2.5 MHz Pbar Longitudinal Emittance



Pbar Coalescing Efficiency vs Pbar Longitudinal Emittance for the 2.5 MHz Transfers



Pbar Coalescing Efficiency vs Longitudinal Emittance at 150 GeV for the 2.5 MHz Transfers